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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Mathematics 4301
Specification A
2008

Material accompanying this Specification

- Specimen Assessment Materials
- A Teacher's Guide

SPECIFICATION

This specification will be published annually on the AQA Website (www.aqa.org.uk). If there are any changes to the specification centres will be notified in print as well as on the Website. The version on the Website is the definitive version of the specification.

Further copies of this specification booklet are available from:

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Background Information

1 Introduction

Following a review of the National Curriculum requirements, and the establishment of the National Qualifications Framework, all the unitary awarding bodies revised their GCSE syllabuses for first examination in 2003. These specifications have been further revised for examination in 2008 to incorporate necessary changes in moving to two tiers of assessment. This new specification will be used by schools and colleges for two-year courses starting in September 2006.

1.1 National Qualifications Framework

GCSE qualifications have the following equivalence in the National Qualifications Framework.

Grades A* – C = Level 2
Grades D – G = Level 1

1.2 Requirements at GCSE

ICT

The subject content of all GCSEs must require candidates to make effective use of ICT and provide, where appropriate, assessment opportunities for ICT. Details of how the teaching of this specification can encourage the application and development of ICT skills are given in Section 9. However, ICT skills are not assessed by any component of this specification.

Key Skills

All GCSE specifications must identify, as appropriate, opportunities for generating evidence on which candidates may be assessed in the 'main' Key Skills of *Communication, Application of Number* and *Information and Communication Technology* at the appropriate level(s). Also, where appropriate, they must identify opportunities for developing and generating evidence for addressing the 'wider' Key Skills of *Working with Others, Improving own Learning and Performance* and *Problem Solving*.

Communication	All GCSE specifications must ensure that the assessment arrangements require that, when they produce extended written material, candidates have to: • ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear • present information in a form that suits its purpose • use a suitable structure and style of writing. Further details for this specification are given in Section 6.2.
Tiering	In GCSE Mathematics the scheme of assessment must include question papers targeted at two tiers of grades: A* – D (Higher), and C – G (Foundation). Candidates should be entered at the tier appropriate to their attainment. Candidates who fail to achieve the mark for the lowest grade available at each tier will be recorded as unclassified (U).
Citizenship	From 2002, students in England have been required to study Citizenship as a national curriculum subject. Each GCSE specification must signpost, where appropriate, opportunities for developing citizenship knowledge, skills and understanding. Further details for this specification are given in Section 11.
Other Issues	All specifications must identify ways in which the study of the subject can contribute to developing understanding of spiritual, moral, ethical, social and cultural issues, European developments, environmental issues, and health and safety. Further details for this specification are given in Section 11.
Wales and Northern Ireland	Centres in Northern Ireland/Wales must refer to the Statement in Section 8.1 of this specification.

1.3 The Mathematics Criteria

- Internal assessment is compulsory.
- Internal assessment comprises two tasks:
  - (i) the AO4 task – a handling data task which counts as half of the AO4 weighting;
  - (ii) the AO1 task – an investigative task which assesses AO1 in the context of AO2 and/or AO3 and counts as half of the AO1 weighting.
- The other halves of the AO1 and AO4 weightings are assessed in the written papers.
- The overall subject content is the same as the 2007 specification. Changes are to accommodate only the different tiering arrangements.
- Some questions demanding the unprompted solution of multi-step problems are required.
- Grade descriptions have been modified slightly.

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Specification at a Glance
Mathematics A

- This is one of two Mathematics specifications offered by AQA. Specification A is a traditional linear scheme; Specification B is modular and is suitable for both pre-16 and post-16 candidates.
- There are two tiers of assessment, Foundation (C-G) and Higher (A*-D).

GCSE Mathematics A (4301)	
Paper 1	
Written Paper (Non-Calculator)	40% of total marks
Foundation Tier Higher Tier	1 hour 30 minutes 2 hours
Paper 2	
Written Paper (Calculator)	40% of total marks
Foundation Tier Higher Tier	1 hour 30 minutes 2 hours
Coursework	
Both tiers	20% of total marks
Either Option T Centre-set or AQA-set tasks Centre-marked	**Or** Option X AQA-set tasks AQA-marked

Foundation Tier
Option T 4301TF Option X 4301XF
Higher Tier
Option T 4301TH Option X 4301XH

3 Availability of Assessment Units and Entry Details

3.1 Availability of Assessment Units

Examinations will be available as follows:

Availability of Papers by Tier			Availability of Qualification
	F	H	
June Series	✓	✓	✓
November Series	✓	✓	✓

June 2008 will be the first series.

3.2 Entry Codes

Normal entry requirements apply, but the following information should be noted.

The **Subject Code** for entry to the GCSE award is 4301.

3.3 Classification Codes

Each specification is assigned to a national classification code, indicating the subject area to which it belongs.

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code, will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

The classification code for this specification is 2210

3.4 Private Candidates

Private candidates should normally enter for Specification A Option X. Specification A Option T is available for private candidates only where

- the candidate attends an AQA centre which will supervise the coursework, or,
- the candidate is repeating the examination and has a moderated coursework mark that can be carried forward (see Section 17.4).

Private candidates should write to AQA for a copy of *Supplementary Guidance for Private Candidates*.

3.5	Special Consideration	Special consideration may be requested for candidates whose work has been affected by illness or other exceptional circumstances. The appropriate form and all relevant information should be forwarded to the AQA office which deals with such matters for the centre concerned. Special arrangements may be provided for candidates with special needs. Details are available from the AQA Website (www.aqa.org.uk). Centres contacting AQA should ask for a copy of "*Regulations and Guidance relating to Candidates who are Eligible for Adjustments in Examinations*".
3.6	Access Arrangements	Special arrangements may be provided for candidates with special needs. Details are available from the AQA Website (www.aqa.org.uk). Centres contacting AQA should ask for the Candidate Services Departments and a copy of "*Regulations and Guidance relating to Candidates who are Eligible for Adjustments in Examinations*".
3.7	Language of Examinations	All components are provided in English only.

Scheme of Assessment

4 Introduction

4.1	National Criteria	This GCSE Mathematics Specification complies with the following: The GCSE Subject Criteria for Mathematics; The GCSE and GCE A/AS Code of Practice; The GCSE Qualification Specific Criteria; The Arrangements for the Statutory Regulation of External Qualifications in England, Wales and Northern Ireland: Common Criteria.

4.2 Rationale

AQA offers a suite of qualifications for GCSE Mathematics. Specification A is a traditional linear scheme. Specification B is a modular scheme suitable for both pre-16 and post-16 candidates.

Specification A and Specification B have common coursework tasks; this allows candidates the flexibility to move from one scheme of assessment to the other.

Mathematics is essentially a holistic subject and, as such, should be taught in this way with connections being made between the sections on *Number and algebra, Shape, space and measures* and *Handling data* as demanded in the National Curriculum. For example, *Number* underpins the whole of mathematics. The scheme of assessment supports this style of teaching.

Specification A is a traditional scheme with written assessment at the end of the course. This allows candidates to develop a mature understanding of the subject before being assessed. Specification A provides a natural link between Key Stage 3 and Advanced level Mathematics.

There are two options within Specification A, allowing alternative approaches to the assessment of coursework. In Option T, centres may choose from a bank of coursework tasks provided by AQA or set their own coursework tasks; centres mark their own coursework tasks with moderation of candidates' coursework by AQA. In Option X, centres must choose from the bank of coursework tasks provided by AQA (AQA-set tasks) and candidates' coursework is marked by AQA.

4.3 Prior level of attainment and recommended prior learning

There is progression of material through all levels at which the subject is studied. This specification therefore builds on the Key Stage 3 Programme of Study.

It is also expected that candidates will have reached the required level of literacy through study at Key Stage 3.

4.4 Progression

This qualification is a recognised part of the National Qualifications Framework. As such, GCSE Mathematics provides progression from Key Stage 3 to GCE A/AS Mathematics or further study at Advanced or Advanced Subsidiary level in other subjects or further study at GNVQ level, or directly into employment.

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Aims

The aims set out below are consistent with the 1999 National Curriculum Order for Mathematics and the GCSE Criteria for Mathematics. Most of the aims are reflected in the Assessment Objectives; others are not because they cannot be readily translated into assessment objectives.

A course based on this specification should encourage candidates to

a consolidate their understanding of mathematics;

b be confident in their use of mathematics;

c extend their use of mathematical vocabulary, definitions and formal reasoning;

d develop the confidence to use mathematics to tackle problems in the work place and everyday life;

e take increasing responsibility for the planning and execution of their work;

f develop an ability to think and reason mathematically;

g learn the importance of precision and rigour in mathematics;

h make connections between different areas of mathematics;

i realise the application of mathematics in the world around them;

j use ICT appropriately;

k develop a firm foundation for appropriate further study.

6 Assessment Objectives

6.1 Assessment Objectives

A course based on this specification requires candidates to demonstrate their knowledge, understanding and skills in the following Assessment Objectives. These relate to the knowledge, skills and understanding in the National Curriculum Programme of Study:

AO1 *Using and applying mathematics*

AO2 *Number and algebra*

AO3 *Shape, space and measures*

AO4 *Handling data*

The Assessment Objective AO1, *Using and applying mathematics,* will be assessed in contexts provided by the other Assessment Objectives.

6.2 Quality of Written Communication

This specification does not formally assess the quality of written communication.

7 Scheme of Assessment

7.1 Assessment Units

The Scheme of Assessment comprises three components.

Candidates are entered for either Option T or Option X.

Option T

Written Paper	
Paper 1 (Non-calculator)	
Foundation Tier	1 hour 30 minutes
Higher Tier	2 hours
40% of the marks	100 marks

The same paper is used in Option X.

All Assessment Objectives are assessed. All questions are compulsory. A question and answer booklet will be provided.

Written Paper	
Paper 2 (Calculator)	
Foundation Tier	1 hour 30 minutes
Higher Tier	2 hours
40% of the marks	100 marks

The same paper is used in Option X.

All Assessment Objectives are assessed. All questions are compulsory. A question and answer booklet will be provided.

Coursework	
20% of the marks	48 marks
Centre-set or AQA-set	
Centre-marked	
AQA-moderated	

Two equally weighted coursework tasks:

- one in the context of AO2 and/or AO3 (AO1 task);
- one in the context of AO4 (AO4 task).

Centres may select their own tasks or choose from the bank of tasks provided by AQA.

Option X

Written Paper
Paper 1 (Non-calculator)

Foundation Tier	1 hour 30 minutes
Higher Tier	2 hours
40% of the marks	100 marks

The same paper is used in Option T.

All Assessment Objectives are assessed. All questions are compulsory. A question and answer booklet will be provided.

Written Paper
Paper 2 (Calculator)

Foundation Tier	1 hour 30 minutes
Higher Tier	2 hours
40% of the marks	100 marks

The same paper is used in Option T.

All Assessment Objectives are assessed. All questions are compulsory. A question and answer booklet will be provided.

Coursework

20% of the marks	48 marks

AQA-set
AQA-marked

Two equally weighted coursework tasks:

- one in the context of AO2 and/or AO3 (AO1 task);
- one in the context of AO4 (AO4 task).

Centres must select tasks from the bank of tasks provided by AQA.

7.2 Weighting of Assessment Objectives

The approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table:

Assessment Objectives	**Component Weightings (%)**		**Overall Weighting of AOs (%)**
	Written Papers	**Coursework**	
AO1 Using and applying mathematics	10*	10	20
AO2 Number and algebra	40		40
AO3 Shape, space and measures	20		20
AO4 Handing data	10	10	20
Overall Weighting of Units (%)	**80**	**20**	**100**

Candidates' marks for each assessment are scaled to achieve the correct weightings.

* On the written papers the assessment of AO1 is subsumed within the other Assessment Objectives covered by the Module. Thus 10% of the total written paper assessment will also assess *Using and Applying Mathematics* within the contexts of the questions.

7.3 Written Papers

The written papers at both tiers are designed so that 50% of the marks are focussed on the lowest two grades available. 25-30% of marks will focus on the highest two grades.

Common questions will be set on papers across the two tiers. Formulae sheets for Foundation and Higher tier papers are provided in Appendix B and on page 2 of each examination paper. Some questions will be designed to assess the unprompted solution of multi-step problems.

The use of a calculator is not permitted with Paper 1. Slide rules, logarithmic tables and all other calculating aids are also forbidden. On Paper 2 candidates will be required to demonstrate the effective use of a calculator.

7.4	Calculators	Candidates will be expected to have a suitable electronic calculator for use with Paper 2. The calculator should have the following as a minimum requirement: four rules and a square, square root, reciprocal and power function, brackets, a memory facility and appropriate exponential, trigonometric and statistical functions. Further guidance on regulations relating to calculators can be obtained from *Instructions on the Conduct of Examinations*.
7.5	Coursework	Apart from the choice of coursework tasks and the method of assessment, the nature of the coursework (centre-assessed) component is the same for both Option T and Option X. Information about the administrative arrangements for both options can be found in Sections 12 – 18 of this specification.
7.6	Entry Policy	Centres are encouraged to enter candidates aiming to achieve grades D, E, F and G for the Foundation tier and grades A*, A, B and C for the Higher tier.

Subject Content

8 Summary of Subject Content

8.1 Introduction

There are two tiers of entry for GCSE Mathematics candidates: Foundation and Higher. In the National Curriculum, published in 1999, the Key Stage 4 Programme of Study was divided into two tiers. The division of the Programme of Study into two tiers in the subject content of this specification is common to all Awarding Bodies. Thus:

- the subject content unique to the Foundation tier is based on the Foundation Programme of Study;
- the subject content common to both tiers and of the Higher tier only is based on the Higher Programme of Study;
- in general, the Higher tier content of the specification subsumes the Foundation tier content.

This GCSE Specification has been written against the Key Stage 4 Programme of Study for England. Candidates entering for this GCSE in Northern Ireland and Wales must be taught all the material required by the National Curriculum in their own country.

8.2 Assessment Objectives

Within this specification the subject content is presented under the following Assessment Objectives.

The Assessment Objective AO1 (*Using and applying mathematics*) is assessed in contexts provided by the other Assessment Objectives.

AO2 Number and algebra

1 Using and applying number and algebra
2 Numbers and the number system
3 Calculations
4 Solving numerical problems
5 Equations, formulae and identities
6 Sequences, functions and graphs

AO3 Shape, space and measures

1 Using and applying shape, space and measures
2 Geometrical reasoning
3 Transformations and coordinates
4 Measures and construction

AO4 Handling data

1 Using and applying handling data
2 Specifying the problem and planning
3 Collecting data
4 Processing and representing data
5 Interpreting and discussing results

8.3 Breadth of Study

In addition to the required knowledge, skills and understanding, the National Curriculum Programme of Study also specifies the Breadth of Study expected.

Foundation Tier

Pupils should be taught the knowledge, skills and understanding through:

a extending mental and written calculation strategies and using efficient procedures confidently to calculate with integers, fractions, decimals, percentages, ratio and proportion;

b solving a range of familiar and unfamiliar problems, including those drawn from real-life contexts and other areas of the curriculum;

c activities that provide frequent opportunities to discuss their work, to develop reasoning and understanding and to explain their reasoning and strategies;

d activities focused on developing short chains of deductive reasoning and the correct use of the '=' sign;

e activities in which they do practical work with geometrical objects, visualise them and work with them mentally;

f practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data;

g activities focused on the major ideas of statistics, including using appropriate populations and representative samples, using different measurement scales, using probability as a measure of uncertainty, using randomness and variability, reducing bias in sampling and measuring, and using inference to make decisions;

h substantial use of tasks focused on using appropriate ICT (for example, spreadsheets, databases, geometry or graphic packages), using calculators correctly and efficiently, and knowing when not to use a calculator.

Higher Tier

Pupils should be taught the knowledge, skills and understanding through:

a activities that ensure they become familiar with and confident using standard procedures for the range of calculations appropriate to this level of study;

b solving familiar and unfamiliar problems in a range of numerical, algebraic and graphical contexts and in open-ended and closed form;

c using standard notations for decimals, fractions, percentages, ratio and indices;

d activities that show how algebra, as an extension of number using symbols, gives precise form to mathematical relationships and calculations;

e activities in which they progress from using definitions and short chains of reasoning to understanding and formulating proofs in algebra and geometry;

f a sequence of practical activities that address increasingly demanding statistical problems in which they draw inferences from data and consider the uses of statistics in society;

g choosing appropriate ICT tools and using these to solve numerical and graphical problems, to represent and manipulate geometrical configurations and to present and analyse data.

8.4 Subject Content Presentation

The subject content, Section 9, is shown in two columns. Column 1 shows the content which will be explicitly assessed on the Foundation tier only, although a thorough knowledge of this content is assumed in the Higher tier assessment.

Column 2 shows the content which will be assessed on the Higher tier only.

The subject content is taken directly from the Statutory Orders for Mathematics, 1999.

Each statement is referenced to the appropriate statement in the Foundation or Higher Programme of Study. Thus, F2.la refers to AO2, Foundation Programme of Study statement 1a.

9 Subject Content

AO2 Number and algebra

1 Using and applying number and algebra

Pupils should be taught to:

Foundation Tier		Higher Tier	
Problem solving			
F2.1a	select and use suitable problem-solving strategies and efficient techniques to solve numerical and algebraic problems	H2.1a	select and use appropriate and efficient techniques and strategies to solve problems of increasing complexity, involving numerical and algebraic manipulation
H2.1b	identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches	H2.1b	identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches
F2.1b H2.1c	break down a complex calculation into simpler steps before attempting to solve it	H2.1c	break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods
F2.1c	use algebra to formulate and solve a simple problem – identifying the variable, setting up an equation, solving the equation and interpreting the solution in the context of the problem		
F2.1d	make mental estimates of the answers to calculations; use checking procedures, including use of inverse operations; work to stated levels of accuracy	H2.1d	make mental estimates of the answers to calculations; present answers to sensible levels of accuracy; understand how errors are compounded in certain calculations

Foundation Tier		Higher Tier	

Communicating

F2.1e	interpret and discuss numerical and algebraic information presented in a variety of forms	H2.1e	discuss their work and explain their reasoning using an increasing range of mathematical language and notation
F2.1f	use notation and symbols correctly and consistently within a given problem	H2.1h	use notation and symbols correctly and consistently within a given problem
F2.1g	use a range of strategies to create numerical, algebraic or graphical representations of a problem and its solution; move from one form of representation to another to get different perspectives on the problem	H2.1f	use a variety of strategies and diagrams for establishing algebraic or graphical representations of a problem and its solution; move from one form of representation to another to get different perspectives on the problem
F2.1h	present and interpret solutions in the context of the original problem	H2.1g	present and interpret solutions in the context of the original problem
F2.1i	review and justify their choice of mathematical presentation	H2.1i	examine critically, improve, then justify their choice of mathematical presentation, present a concise, reasoned argument

Foundation Tier		Higher Tier	

Reasoning

F2.1j	explore, identify, and use pattern and symmetry in algebraic contexts, investigating whether particular cases can be generalised further, and understanding the importance of a counter-example, identify exceptional cases when solving problems	H2.1j	explore, identify, and use pattern and symmetry in algebraic contexts, investigating whether particular cases can be generalised further, and understanding the importance of a counter-example, identify exceptional cases when solving problems
F2.1k	show step-by-step deduction in solving a problem	H2.1l	show step-by-step deduction in solving a problem; derive proofs using short chains of deductive reasoning
F2.1l	understand the difference between a practical demonstration and a proof	H2.1k	understand the difference between a practical demonstration and a proof
F2.1m	recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying the assumptions may have on the solution to a problem	H2.1m	recognise the significance of stating constraints and assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying the assumptions may have on the solution to a problem

2 Numbers and the number system

Pupils should be taught to:

Foundation Tier		Higher Tier	
Integers			
F2.2a H2.2a	use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10; understand and use positive numbers and negative integers both as positions and translations on a number line; order integers; use the concepts and vocabulary of factor (divisor), multiple, common factor., highest common factor, least common multiple, prime number and prime factor decomposition	H2.2a	use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10; understand and use negative integers both as positions and translations on a number line; order integers; use the concepts and vocabulary of factor (divisor), multiple, common factor, highest common factor, least common multiple, prime number and prime factor decomposition
Powers and roots			
F2.2b H2.2b	use the terms square, positive and negative square root, cube and cube root; use index notation for squares, cubes and powers of 10; use index laws for multiplication and division of integer powers; express standard index form both in conventional notation and on a calculator display	H2.2b	use the terms square, positive square root, negative square root, cube and cube root; use index notation and index laws for multiplication and division of integer powers; use standard index form, expressed in conventional notation and on a calculator display
Fractions			
F2.2c	understand equivalent fractions, simplifying a fraction by cancelling all common factors; order fractions by rewriting them with a common denominator	H2.2c	understand equivalent fractions, simplifying a fraction by cancelling all common factors; order fractions by rewriting them with a common denominator

Foundation Tier		Higher Tier	

Decimals

F2.2d H2.2d	use decimal notation and recognise that each terminating decimal is a fraction; recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals; order decimals	H2.2d	use decimal notation and recognise that each terminating decimal is a fraction; recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals; order decimals

Percentages

F2.2e	understand that 'percentage' means 'number of parts per 100' and use this to compare proportions; interpret percentage as the operator 'so many hundredths of'; use percentage in real-life situations	F2.2e H2.2e	understand that 'percentage' means 'number of parts per 100' and use this to compare proportions; interpret percentage as the operator 'so many hundredths of'; use percentage in real-life situations

Ratio

F2.2f	use ratio notation, including reduction to its simplest form and its various links to fraction notation	H2.2f	use ratio notation, including reduction to its simplest form and its various links to fraction notation

3 Calculations

Pupils should be taught to:

Foundation Tier		Higher Tier	
Number operations and the relationships between them			
F2.3a H2.3a	add, subtract, multiply and divide integers and then any number; multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1; find the prime factor decomposition of positive integers; understand 'reciprocal' as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, because division by zero is not defined); multiply and divide by a negative number; use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer powers; use inverse operations	H2.3a	multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1; find the prime factor decomposition of positive integers; understand 'reciprocal' as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, because division by zero is not defined); multiply and divide by a negative number; use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer, fractional and negative powers; use inverse operations, understanding that the inverse operation of raising a positive number to power n is raising the result of this operation to power $\frac{1}{n}$
F2.3b	use brackets and the hierarchy of operations	H2.3b	use brackets and the hierarchy of operations
F2.3c	calculate a given fraction of a given quantity, expressing the answer as a fraction; express a given number as a fraction of another; add and subtract fractions by writing them with a common denominator; perform short division to convert a simple fraction to a decimal	H2.3c	calculate a given fraction of a given quantity, expressing the answer as a fraction; express a given number as a fraction of another; add and subtract fractions by writing them with a common denominator; perform short division to convert a simple fraction to a decimal; distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by terminating decimals), and other fractions (which are represented by recurring decimals); convert a recurring decimal to a fraction

Foundation Tier		Higher Tier	
F2.3d H2.3d	understand and use unit fractions as multiplicative inverses; multiply and divide a fraction by an integer, by a unit fraction and by a general fraction	H2.3d	understand and use unit fractions as multiplicative inverses; multiply and divide a given fraction by an integer, by a unit fraction and by a general fraction
F2.3e	convert simple fractions of a whole to percentages of the whole and vice versa, then understand the multiplicative nature of percentages as operators	H2.3e	convert simple fractions of a whole to percentages of the whole and vice versa; then understand the multiplicative nature of percentages as operators; calculate an original amount when given the transformed amount after a percentage change; reverse percentage problems
F2.3f	divide a quantity in a given ratio	H2.3f	divide a quantity in a given ratio

Mental methods

F2.3g H2.3g	recall all positive integer complements to 100; recall all multiplication facts to 10×10, and use them to derive quickly the corresponding division facts; recall integer squares from 11×11 to 15×15 and the corresponding square roots, recall the cubes of 2, 3, 4, 5 and 10, and the fraction-to-decimal conversion of familiar simple fractions	H2.3g	recall integer squares from 2×2 to 15×15 and the corresponding square roots, the cubes of 2, 3, 4, 5 and 10, the fact that $n^0 = 1$ and $n^{-1} = \frac{1}{n}$ for positive integers n, the corresponding rule for negative numbers, $n^{\frac{1}{2}} = \sqrt{n}$ and $n^{\frac{1}{3}} = \sqrt[3]{n}$ for any positive number n
F2.3h	round to the nearest integer and to one significant figure; estimate answers to problems involving decimals	H2.3h	round to a given number of significant figures; develop a range of strategies for mental calculation; derive unknown facts from those they know; convert between ordinary and standard index form representations, converting to standard index form to make sensible estimates for calculations involving multiplication and/or division

Foundation Tier		Higher Tier	
F2.3i	develop a range of strategies for mental calculation; derive unknown facts from those they know; add and subtract mentally numbers with up to two decimal places; multiply and divide numbers with no more than one decimal digit, using the commutative, associative, and distributive laws and factorisation where possible, or place value adjustments	F2.3i	develop a range of strategies for mental calculation; add and subtract mentally numbers with up to two decimal places; multiply and divide numbers with no more than one decimal digit, using the commutative, associative, and distributive laws and factorisation where possible, or place value adjustments

Written methods

F2.3j	use standard column procedures for addition and subtraction of integers and decimals		
F2.3k	use standard column procedures for multiplication of integers and decimals, understanding where to position the decimal point by considering what happens if they multiply equivalent fractions; solve a problem involving division by a decimal (up to 2 d.p.) by transforming it to a problem involving division by an integer	F2.3k	division by decimal (up to 2 d.p.) by division using an integer; understand where to position the decimal point by considering what happens if they multiply equivalent fractions, e.g. given that…work out…
F2.3l	use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer	H2.3i	use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer
F2.3m	solve simple percentage problems, including increase and decrease	H2.3j	solve percentage problems, including percentage increase and decrease; and reverse percentages
F2.3n	solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution	F2.3n	solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution

Foundation Tier		Higher Tier	
		H2.3k	represent repeated proportional change using a multiplier raised to a power
		H2.3l	calculate an unknown quantity from quantities that vary in direct or inverse proportion
		H2.3m	calculate with standard index form
H2.3n	use π in exact calculations, without a calculator	H2.3n	use surds and π in exact calculations, without a calculator; rationalise a denominator such as $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$

Calculator methods

F2.3o	use calculators effectively and efficiently; know how to enter complex calculations and use function keys for reciprocals, squares and powers	H2.3o	use calculators effectively and efficiently, knowing how to enter complex calculations; use an extended range of function keys, including trigonometrical and statistical functions relevant across this programme of study
F2.3p	enter a range of calculations, including those involving standard index form and measures	F2.3p	enter a range of calculations, including those involving measures
F2.3q H2.3p	understand the calculator display, knowing when to interpret the display, when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation	H2.3p	understand the calculator display, knowing when to interpret the display, when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation
		H2.3q	use calculators, or written methods, to calculate the upper and lower bounds of calculations, particularly when working with measurements
		H2.3r	use standard index form display and know how to enter numbers in standard index form

Foundation Tier	Higher Tier	
	H2.3s	use calculators for reverse percentage calculations by doing an appropriate division
	H2.3t	use calculators to explore exponential growth and decay, using a multiplier and the power key

4 Solving numerical problems

Pupils should be taught to:

Foundation Tier		Higher Tier	
F2.4a H2.4a	draw on their knowledge of operations, inverse operations and the relationships between them, and of simple integer powers and their corresponding roots, and of methods of simplification (including factorisation and the use of the commutative, associative and distributive laws of addition, multiplication and factorisation) in order to select and use suitable strategies and techniques to solve problems and word problems, including those involving ratio and proportion, fractions, percentages and measures and conversion between measures, and compound measures defined within a particular situation	H2.4a	draw on their knowledge of operations and inverse operations (including powers and roots), and of methods of simplification (including factorisation and the use of the commutative, associative and distributive laws of addition, multiplication and factorisation) in order to select and use suitable strategies and techniques to solve problems and word problems, including those involving ratio and proportion, repeated proportional change, fractions, percentages and reverse percentages, inverse proportion, surds, measures and conversion between measures, and compound measures defined within a particular situation
F2.4b	select appropriate operations, methods and strategies to solve number problems, including trial and improvement where a more efficient method to find the solution is not obvious		
F2.4c H2.4b	estimate answers to problems; use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude	H2.4b	check and estimate answers to problems; select and justify appropriate degrees of accuracy for answers to problems; recognise limitations on the accuracy of data and measurements

Foundation Tier		Higher Tier
F2.4d	give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display, and recognising limitations on the accuracy of data and measurements	

5 Equations, formulae and identities

Pupils should be taught to:

Foundation Tier		Higher Tier	
Use of symbols			
F2.5a H2.5a	distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number, and knowing that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae , general, unspecified and independent numbers in identities, and in functions they define new expressions or quantities by referring to known quantities	H2.5a	distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number, and knowing that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae, general, unspecified and independent numbers in identities, and in functions they define new expressions or quantities by referring to known quantities
F2.5b H2.5b	understand that the transformation of algebraic expressions obeys and generalises the rules of generalised arithmetic, expand the product of two linear expressions; manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors; distinguish in meaning between the words 'equation', 'formula', 'identity' and 'expression'	H2.5b	understand that the transformation of algebraic entities obeys and generalises the well-defined rules of generalised arithmetic; expand the product of two linear expressions; manipulate algebraic expressions by collecting like terms, multiplying a single term over a bracket, taking out common factors, factorising quadratic expressions including the difference of two squares and cancelling common factors in rational expressions
		H2.5c	know the meaning of and use the words ‘equation’, ‘formula’, ‘identity’ and ‘expression’

Foundation Tier		Higher Tier	

Index notation

F2.5c	use index notation for simple integer powers, and simple instances of index laws; substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$	H2.5d	use index notation for simple integer powers, and simple instances of index laws; substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$

Inequalities

F2.5d	solve simple linear inequalities in one variable, and represent the solution set on a number line	H2.5j	solve linear inequalities in one variable, and represent the solution set on a number line; solve several linear inequalities in two variables and find the solution set

Equations

H2.5e	set up simple equations; solve simple equations by using inverse operations or by transforming both sides in the same way	H2.5e	set up simple equations; solve simple equations by using inverse operations or by transforming both sides in the same way

Linear Equations

F2.5e	solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation; solve linear equations that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution	H2.5f	solve linear equations in one unknown, with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation; solve linear equations that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution

Foundation Tier	Higher Tier

Formulae

F2.5f	use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols; substitute numbers into a formula; derive a formula and change its subject	H2.5g	use formulae from mathematics and other subjects; substitute numbers into a formula; change the subject of a formula including cases where the subject occurs twice, or where a power of the subject appears; generate a formula

Direct and inverse proportion

H2.5h	set up and use equations to solve word and other problems involving direct proportion or inverse proportion and relate algebraic solutions to graphical representation of the equations

Simultaneous linear equations

H2.5i	Find the exact solutions of two simultaneous equations in two unknowns by eliminating a variable and interpret the equations as lines and their common solution as the point of intersection

Quadratic equations

H2.5k	solve quadratic equations by factorisation, completing the square and using the quadratic formula

Foundation Tier	Higher Tier

Simultaneous linear and quadratic equations

		H2.5l	solve exactly, by elimination of an unknown, two simultaneous equations in two unknowns, one of which is linear in each unknown, and the other is linear in one unknown and quadratic in the other, or where the second is of the form $x^2 + y^2 = r^2$

Numerical Methods

H2.5m	use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them	H2.5m	use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them

6 Sequences, functions and graphs

Pupils should be taught to:

Foundation Tier		Higher Tier	

Sequences

F2.6a H2.6a	generate terms of a sequence using term-to-term and position-to-term definitions of the sequence; generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers); use linear expressions to describe the *n*th term of an arithmetic sequence, justifying its form by referring to the activity or context from which it was generated	H2.6a	generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers); generate terms of a sequence using term-to-term and position-to-term definitions of the sequence; use linear expressions to describe the *n*th term of an arithmetic sequence, justifying its form by reference to the activity or context from which it was generated

Graphs of linear functions

F2.6b	use the conventions for coordinates in the plane; plot points in all four quadrants; recognise (when values are given for m and c) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane; plot graphs of functions in which y is given explicitly in terms of x, or implicitly	H2.6b	use conventions for coordinates in the plane; plot points in all four quadrants; recognise (when values are given for m and c) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane; plot graphs of functions in which y is given explicitly in terms of x, or implicitly; no table or axes given
F2.6c	construct linear functions from real-life problems and plot their corresponding graphs; discuss and interpret graphs modelling real situations; understand that the point of intersection of two different lines in the same two variables that simultaneously describe a real situation is the solution to the simultaneous equations represented by the lines; draw line of best fit through a set of linearly related points and find its equation	H2.6c	find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c); understand that the form $y = mx + c$ represents a straight line and that m is the gradient of the line and c is the value of the y – intercept; explore the gradients of parallel lines and lines perpendicular to each other

Foundation Tier	Higher Tier

Gradients

F2.6e	find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c); investigate the gradients of parallel lines

Interpret graphical information

F2.6e	interpret information presented in a range of linear and non-linear graphs	H2.6d	construct linear functions and plot the corresponding graphs arising from real-life problems; discuss and interpret graphs modelling real situations

Quadratic functions

H2.6e	generate points and plot graphs of simple quadratic functions , then more general quadratic functions; find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function	H2.6e	generate points and plot graphs of simple quadratic functions, then more general quadratic functions; find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function; find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions

Foundation Tier	Higher Tier

Other functions

H2.6f	plot graphs of simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, the exponential function $y = k^x$ for integer values of x and simple positive values of k, the circular functions $y = \sin x$ and $y = \cos x$, using a spreadsheet or graph plotter as well as pencil and paper; recognise the characteristic shapes of all these functions

Transformation of functions

H2.6g	apply to the graph of $y = f(x)$ the transformations $y = f(x) + a$, $y = f(ax)$, $y = f(x + a)$, $y = af(x)$ for linear, quadratic, sine and cosine functions $f(x)$

Loci

H2.6h	construct the graphs of simple loci including the circle $x^2 + y^2 = r^2$ for a circle of radius r centred at the origin of coordinates; find graphically the intersection points of a given straight line with this circle and know that this corresponds to solving the two simultaneous equations representing the line and the circle

AO3: Shape, space and measures

1 Using and applying shape, space and measures

Pupils should be taught to:

Foundation Tier		Higher Tier	
Problem solving			
F3.1a H3.1a	select problem-solving strategies and resources, including ICT tools, to use in geometrical work, and monitor their effectiveness; consider and explain the extent to which the selections they made were appropriate	H3.1a	select the problem-solving strategies to use in geometrical work, and consider and explain the extent to which the selections they made were appropriate
F3.1b	select and combine known facts and problem-solving strategies to solve complex problems	H3.1b	select and combine known facts and problem-solving strategies to solve more complex geometrical problems
F3.1c H3.1c	identify what further information is needed to solve a geometrical problem; break complex problems down into a series of tasks; develop and follow alternative lines of enquiry	H3.1c	develop and follow alternative lines of enquiry, justifying their decisions to follow or reject particular approaches

Foundation Tier	Higher Tier

Communicating

F3.1d	interpret, discuss and synthesise geometrical information presented in a variety of forms		
F3.1e H3.1d	communicate mathematically with emphasis on a critical examination of the presentation and organisation of results, and on effective use of symbols and geometrical diagrams	H3.1d	communicate mathematically, with emphasis on a critical examination of the presentation and organisation of results, and on effective use of symbols and geometrical diagrams
F3.1f	use geometrical language appropriately	H3.1e	use precise formal language and exact methods for analysing geometrical configurations
F3.1g	review and justify their choices of mathematics presentation	F3.1g	review and justify their choices of mathematics presentation

Reasoning

F3.1h	distinguish between practical demonstrations and proofs	F3.1h	distinguish between practical demonstrations and proofs
F3.1i	apply mathematical reasoning, explaining and justifying inferences and deductions	H3.1f	apply mathematical reasoning, progressing from brief mathematical explanations towards full justifications in more complex contexts
		H3.1g	explore connections in geometry; pose conditional constraints of the type 'If… then…'; and ask questions 'What if…?' or 'Why?'
F3.1j	show step-by-step deduction in solving a geometrical problem	H3.1h	show step-by-step deduction in solving a geometrical problem
F3.1k	state constraints and give starting points when making deductions	H3.1i	state constraints and give starting points when making deductions

Foundation Tier		Higher Tier	
F3.1l	recognise the limitations of any assumptions that are made; understand the effects that varying the assumptions may have on the solution	H3.1j	understand the necessary and sufficient conditions under which generalisations, inferences and solutions to geometrical problems remain valid
F3.1m	identify exceptional cases when solving geometrical problems		

2 Geometrical reasoning

Pupils should be taught to:

Foundation Tier		Higher Tier	

Angles

F3.2a	recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex
F3.2b	distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees

Foundation Tier		Higher Tier	

Properties of triangles and other rectilinear shapes

F3.2c H3.2a	distinguish between lines and line segments; use parallel lines, alternate angles and corresponding angles; understand the consequent properties of parallelograms and a proof that the angle sum of a triangle is 180 degrees; understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices	H3.2a	distinguish between lines and line segments; use parallel lines, alternate angles and corresponding angles; understand the consequent properties of parallelograms and a proof that the angle sum of a triangle is 180 degrees; understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices
F3.2d	use angle properties of equilateral, isosceles and right-angled triangles; understand congruence; explain why the angle sum of a quadrilateral is 360 degrees	H3.2b	use angle properties of equilateral, isosceles and right-angled triangles; explain why the angle sum of a quadrilateral is 360 degrees
F3.2e	use their knowledge of rectangles, parallelograms and triangles to deduce formulae for the area of a parallelogram, and a triangle, from the formula for the area of a rectangle	F3.2e	use their knowledge of rectangles, parallelograms and triangles to deduce formulae for the area of a parallelogram, and a triangle, from the formula for the area of a rectangle
F3.2f H3.2c	recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; classify quadrilaterals by their geometric properties	H3.2c	recall the definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; classify quadrilaterals by their geometric properties

Foundation Tier		Higher Tier	

Properties of triangles and other rectilinear shapes

F3.2g	calculate and use the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons; calculate and use the angles of regular polygons.	H3.2d	calculate and use the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons; calculate and use the angles of regular polygons.
		H3.2e	understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and compass constructions
F3.2h	understand, recall and use Pythagoras' theorem	H3.2f	understand, recall and use Pythagoras' theorem in 2-D, then 3-D problems; investigate the geometry of cuboids including cubes, and shapes made from cuboids, including the use of Pythagoras' theorem to calculate lengths in three dimensions
		H3.2g	understand similarity of triangles and of other plane figures, and use this to make geometric inferences; understand, recall and use trigonometrical relationships in right-angled triangles, and use these to solve problems, including those involving bearings, then use these relationships in 3-D contexts, including finding the angles between a line and a plane (but not the angle between two planes or between two skew lines); calculate the area of a triangle using $\frac{1}{2}ab\sin C$; draw, sketch and describe the graphs of trigonometric functions for angles of any size, including transformations involving scalings in either or both the x and y directions; use the sine and cosine rules to solve 2-D and 3-D problems

Foundation Tier		Higher Tier	

Properties of circles

F3.2i	recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment; understand that inscribed regular polygons can be constructed by equal division of a circle	H3.2h	recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment; understand that the tangent at any point on a circle is perpendicular to the radius at that point; understand and use the fact that tangents from an external point are equal in length; explain why the perpendicular from the centre to a chord bisects the chord; understand that inscribed regular polygons can be constructed by equal division of a circle; prove and use the facts that the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference, the angle subtended at the circumference by a semicircle is a right angle, that angles in the same segment are equal, and that opposite angles of a cyclic quadrilateral sum to 180 degrees; prove and use the alternate segment theorem

3-D shapes

F3.2j	explore the geometry of cuboids (including cubes), and shapes made from cuboids		
F3.2k H3.2i	use 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation; solve problems involving surface areas and volumes of prisms and cylinders	H3.2i	use 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation; solve problems involving surface areas and volumes of prisms, pyramids, cylinders, cones and spheres; solve problems involving more complex shapes and solids, including segments of circles and frustums of cones

3 Transformations and coordinates

Pupils should be taught to:

Foundation Tier	Higher Tier

Specifying transformations

F3.3a H3.3a	understand that rotations are specified by a centre and an (anticlockwise) angle; rotate a shape about the origin, or any other point; measure the angle of rotation using right angles, simple fractions of a turn or degrees; understand that reflections are specified by a mirror line, at first using a line parallel to an axis, then a mirror line such as $y = x$ or $y = -x$; understand that translations are specified by a distance and direction(or a vector), and enlargements by a centre and positive scale factor	H3.3a	understand that rotations are specified by a centre and an (anticlockwise) angle; use any point as the centre of rotation; measure the angle of rotation, using right angles, fractions of a turn or degrees; understand that reflections are specified by a (mirror) line; understand that translations are specified by giving a distance and direction (or a vector), and enlargements by a centre and a positive scale factor

Foundation Tier		Higher Tier	

Properties of transformations

3.3b H3.3b	recognise and visualise rotations, reflections and translations, including reflection symmetry of 2-D and 3-D shapes, and rotation symmetry of 2-D shapes; transform triangles and other 2-D shapes by translation, rotation and reflection and combinations of these transformations, recognising that these transformations preserve length and angle, so that any figure is congruent to its image under any of these transformations; distinguish properties that are preserved under particular transformations	H3.3b	recognise and visualise rotations, reflections and translations including reflection symmetry of 2-D and 3-D shapes, and rotation symmetry of 2-D shapes; transform triangles and other 2-D shapes by translation, rotation and reflection and combinations of these transformations; use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations; distinguish properties that are preserved under particular transformations
F3.3c	recognise, visualise and construct enlargements of objects using positive scale factors greater than one, then positive scale factors less than one; understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not	H3.3c	recognise, visualise and construct enlargements of objects; understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not, then use positive fractional and negative scale factors
F3.3d	recognise that enlargements preserve angle but not length; identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments and apply this to triangles; understand the implications of enlargement for perimeter; use and interpret maps and scale drawings; understand the implications of enlargement for area and for volume; distinguish between formulae for perimeter, area and volume by considering dimensions; understand and use simple examples of the relationship between enlargement and areas and volumes of shapes and solids	H3.3d	recognise that enlargements preserve angle but not length; identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments; understand the implications of enlargement for perimeter; use and interpret maps and scale drawings; understand the difference between formulae for perimeter, area and volume by considering dimensions; understand and use the effect of enlargement on areas and volumes of shapes and solids

Foundation Tier		Higher Tier	

Coordinates

F3.3e	understand that one coordinate identifies a point on a number line, two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'; use axes and coordinates to specify points in all four quadrants; locate points with given coordinates; find the coordinates of points identified by geometrical information; find the coordinates of the midpoint of the line segment AB, given points A and B, then calculate the length AB	H3.3e	understand that one coordinate identifies a point on a number line, that two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'; use axes and coordinates to specify points in all four quadrants; locate points with given coordinates; find the coordinates of points identified by geometrical information; find the coordinates of the midpoint of the line segment AB, given the points A and B, then calculate the length AB

Vectors

F3.3f	understand and use vector notation for translations	H3.3f	understand and use vector notation; calculate, and represent graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector; calculate the resultant of two vectors; understand and use the commutative and associative properties of vector addition; solve simple geometrical problems in 2-D using vector methods

4 Measures and construction

Pupils should be taught to:

Foundation Tier	Higher Tier

Measures

F3.4a	interpret scales on a range of measuring instruments, including those for time and mass; know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; know rough metric equivalents of pounds, feet, miles, pints and gallons; make sensible estimates of a range of measures in everyday settings	H3.4a	use angle measure; know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; understand and use compound measures, including speed and density
F3.4b	understand angle measure using the associated language		
F3.4c H3.4a	understand and use compound measures, including speed and density		

Foundation Tier		Higher Tier	

Construction

F3.4d	measure and draw lines to the nearest millimetre, and angles to the nearest degree; draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and angles; understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not; construct cubes, regular tetrahedra, square-based pyramids and other 3-D shapes from given information	F3.4d H3.4b	draw approximate constructions of triangles and other 2-D shapes, using a ruler and protractor, given information about side lengths and angles; understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not; construct specified cubes, regular tetrahedra, square-based pyramids and other 3-D shapes
F3.4e	use straight edge and compasses to do standard constructions, including an equilateral triangle with a given side, the midpoint and perpendicular bisector of a line segment, the perpendicular from a point to a line, the perpendicular from a point on a line, and the bisector of an angle	H3.4c	use straight edge and compasses to do standard constructions including an equilateral triangle with a given side, the midpoint and perpendicular bisector of a line segment, the perpendicular from a point to a line, the perpendicular from a point on a line, and the bisector of an angle

Foundation Tier		Higher Tier	

Mensuration

F3.4f	find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach; recall and use the formulae for the area of a parallelogram and a triangle; find the surface area of simple shapes using the area formulae for triangles and rectangles; calculate perimeters and areas of shapes made from triangles and rectangles	F3.4f F3.4i H3.4d	calculate perimeters and areas of shapes made from triangles and rectangles; find the surface area of simple shapes by using the formulae for the areas of triangles and rectangles; find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach; calculate volumes of right prisms and of shapes made from cubes and cuboids; convert between area measures, including square centimetres and square metres, and volume measures, including cubic centimetres and cubic metres; find circumferences of circles and areas enclosed by circles, recalling relevant formulae; calculate the lengths of arcs and the areas of sectors of circles
F3.4g	find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach; calculate volumes of right prisms and of shapes made from cubes and cuboids		
F3.4h	find circumferences of circles and areas enclosed by circles, recalling relevant formulae		
F3.4i	convert between area measures, including square centimetres and square metres, and volume measures, including cubic centimetres and cubic metres		

Loci

F3.4j	find loci, both by reasoning and by using ICT to produce shapes and paths	H3.4e	find loci, both by reasoning and by using ICT to produce shapes and paths

AO4 Handling data

1 Using and applying handling data

Pupils should be taught to:

Foundation Tier	Higher Tier

Problem solving

F4.1a	carry out each of the four aspects of the handling data cycle to solve problems: (i) specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed (ii) collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources (iii) process and represent the data: turn the raw data into usable information that gives insight into the problem (iv) interpret and discuss the data: answer the initial question by drawing conclusions from the data	H4.1a	carry out each of the four aspects of the handling data cycle to solve problems: (i) specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed (ii) collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources (iii) process and represent the data: turn the raw data into usable information that gives insight into the problem (iv) interpret and discuss the data: answer the initial question by drawing conclusions from the data

Foundation Tier		Higher Tier	
F4.1b H4.1b	identify what further information is needed to pursue a particular line of enquiry; select the problem-solving strategies to use in statistical work, and monitor their effectiveness (these strategies should address the scale and manageability of the tasks, and should consider whether the mathematics and approach used are delivering the most appropriate solutions)	H4.1b	select the problem-solving strategies to use in statistical work, and monitor their effectiveness (these strategies should address the scale and manageability of the tasks, and should consider whether the mathematics and approach used are delivering the most appropriate solutions)
F4.1c	select and organise the appropriate mathematics and resources to use for a task		
F4.1d	review progress while working; check and evaluate solutions		

Communicating

F4.1e	interpret, discuss and synthesise information presented in a variety of forms		
F4.1f	communicate mathematically, including using ICT, making use of diagrams and related explanatory text	H4.1c	communicate mathematically, with emphasis on the use of an increasing range of diagrams and related explanatory text, on the selection of their mathematical presentation, explaining its purpose and approach, and on the use of symbols to convey statistical meaning
F4.1g	examine critically, and justify, their choices of mathematical presentation of problems involving data		

Foundation Tier		Higher Tier	

Reasoning

F4.1h	apply mathematical reasoning, explaining and justifying inferences and deductions	H4.1d	apply mathematical reasoning, explaining and justifying inferences and deductions, justifying arguments and solutions
H4.1e	identify exceptional or unexpected cases when solving statistical problems	H4.1e	identify exceptional or unexpected cases when solving statistical problems
F4.1i H4.1f	explore connections in mathematics and look for relationships between variables when analysing data	H4.1f	explore connections in mathematics and look for relationships between variables when analysing data
F4.1j	recognise the limitations of any assumptions and the effects that varying the assumptions could have on the conclusions drawn from data analysis	H4.1g	recognise the limitations of any assumptions and the effects that varying the assumptions could have on the conclusions drawn from data analysis

2 Specifying the problem and planning

Pupils should be taught to:

Foundation Tier		Higher Tier	
F4.2a	see that random processes are unpredictable	H4.2a	see that random processes are unpredictable
F4.2b H4.2b	identify key questions that can be addressed by statistical methods	H4.2b	identify key questions that can be addressed by statistical methods
F4.2c	discuss how data relate to a problem, identify possible sources of bias and plan to minimise it	H4.2c	discuss how data relate to a problem, identify possible sources of bias and plan to minimise it
F4.2d	identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals	H4.2d	identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals; select and justify a sampling scheme and a method to investigate a population, including random and stratified sampling
F4.2e H4.2e	design an experiment or survey; decide what primary and secondary data to use	H4.2e	design an experiment or survey; decide what primary and secondary data to use

3 Collecting data

Pupils should be taught to:

Foundation Tier		Higher Tier	
F4.3a	design and use data-collection sheets for grouped, discrete and continuous data; collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys	H4.3a	collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys
F4.3b	gather data from secondary sources, including printed tables and lists from ICT-based sources	H4.3b	gather data from secondary sources, including printed tables and lists from ICT-based sources
F4.3c	design and use two-way tables for discrete and grouped data	H4.3c	design and use two-way tables for discrete and grouped data
		H4.3d	deal with practical problems such as non-response or missing data

4 Processing and representing data

Pupils should be taught to:

Foundation Tier		Higher Tier	
F4.4a	draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs for time series, scatter graphs, frequency diagrams and stem-and-leaf diagrams	H4.4a	draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs (time series), scatter graphs, frequency diagrams, stem-and-leaf diagrams, cumulative frequency tables and diagrams, box plots and histograms for grouped continuous data
F4.4b	calculate mean, range and median of small data sets with discrete then continuous data; identify the modal class for grouped data		
F4.4c	understand and use the probability scale		
F4.4d	understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency	H4.4b	understand and use estimates or measures of probability from theoretical models, or from relative frequency
F4.4e	list all outcomes for single events, and for two successive events, in a systematic way	H4.4c	list all outcomes for single events, and for two successive events, in a systematic way
F4.4f	identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1.	H4.4d	identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1.
F4.4g	find the median for large data sets and calculate an estimate of the mean for large data sets with grouped data	H4.4e	find the median, quartiles and interquartile range for large data sets and calculate the mean for large data sets with grouped data
		H4.4f	calculate an appropriate moving average

Foundation Tier		Higher Tier	
		H4.4g	know when to add or multiply two probabilities: if A and B are mutually exclusive, then the probability of A or B occurring is $P(A) + P(B)$, whereas if A and B are independent events, the probability of A and B occurring is $P(A) \times P(B)$
		H4.4h	use tree diagrams to represent outcomes of compound events, recognising when events are independent
F4.4h	draw lines of best fit by eye, understanding what these represent	H4.4i	draw lines of best fit by eye, understanding what these represent
H4.4j	use relevant statistical functions on a calculator or spreadsheet	H4.4j	use relevant statistical functions on a calculator or spreadsheet

5 Interpreting and discussing results

Pupils should be taught to:

Foundation Tier		Higher Tier	
F4.5a	relate summarised data to the initial questions	H4.5a	relate summarised data to the initial questions
F4.5b	interpret a wide range of graphs and diagrams and draw conclusions	H4.5b	interpret a wide range of graphs and diagrams and draw conclusions; identify seasonality and trends in time series
F4.5c	look at data to find patterns and exceptions	H4.5c	look at data to find patterns and exceptions

Foundation Tier		Higher Tier	
F4.5d	compare distributions and make inferences, using the shapes of distributions and measures of average and range	H4.5d	compare distributions and make inferences, using shapes of distributions and measures of average and spread, including median and quartiles; understand frequency density
F4.5e	consider and check results and modify their approach if necessary	H4.5e	consider and check results, and modify their approach if necessary
F4.5f H4.5f	appreciate that correlation is a measure of the strength of the association between two variables; distinguish between positive, negative and zero correlation using lines of best fit; appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'	H4.5f	appreciate that correlation is a measure of the strength of the association between two variables; distinguish between positive, negative and zero correlation using lines of best fit; appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'
F4.5g	use the vocabulary of probability to interpret results involving uncertainty and prediction	H4.5g	use the vocabulary of probability to interpret results involving uncertainty and prediction
F4.5h	compare experimental data and theoretical probabilities	H4.5h	compare experimental data and theoretical probabilities
F4.5i	understand that if they repeat an experiment, they may – and usually will – get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics	H4.5i	understand that if they repeat an experiment, they may – and usually will – get different outcomes, and that increasing sample size generally leads to better estimates of probability and population parameters
F4.5j	discuss implications of findings in the context of the problem		
F4.5k	interpret social statistics including index numbers; time series; and survey data	F4.5k	interpret social statistics including index numbers; time series; and survey data

Key Skills and Other Issues

10 Key Skills – Teaching, Developing and Providing Opportunities for Generating Evidence

10.1 Introduction

The Key Skills Qualification requires candidates to demonstrate levels of achievement in the Key Skills of *Communication, Application of Number* and *Information and Communication Technology*.

The units for the 'wider' Key Skills of *Working with Others, Improving own Learning and Performance* and *Problem-Solving* are also available. The acquisition and demonstration of ability in these 'wider' Key Skills is deemed highly desirable for all candidates, but they do not form part of the Key Skills Qualification.

Centres intending to use this specification to meet the Key Skills requirements are advised to cross-check the requirement with the QCA documentation.

Copies of the Key Skills Units may be downloaded from the QCA web site (http://www.qca.org.uk/keyskills).

The units for each Key Skill comprise three sections:

A What you need to know.

B What you must do.

C Guidance.

Candidates following a course of study based on this Specification for GCSE Mathematics can be offered opportunities to develop and generate evidence of attainment in aspects of the Key Skills of *Communication, Application of Number, Information and Communication Technology, Working with Others, Improving own Learning and Performance,* and *Problem Solving*. Areas of study and learning that can be used to encourage the acquisition and use of Key Skills, and to provide opportunities to generate evidence for Part B of the units, are signposted below.

10.2 Key Skills Opportunities in Mathematics

The signposting which follows indicates the opportunities to acquire and produce evidence of the Key Skills in AO2-4. AO1, *Using and applying mathematics* which is assessed in the context of AO2-3, also provides opportunities.

Communication Level 1

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
C1.1 Take part in either a **one-to-one** discussion or a **group** discussion.	✓	✓	✓
C1.2 Read and obtain information from at least **one** document.	✓	✓	✓
C1.3 Write **two** different types of documents.	–	–	–

Communication Level 2

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
C2.1a Take part in a group discussion.	✓	✓	✓
C2.1b Give a talk of at least four minutes.	✓	✓	✓
C2.2 Read and summarise information from at least **two** documents about the same subject. Each document must be a minimum of 500 words long.	✓	✓	✓
C2.3 Write **two** different types of documents each one giving different information. One document must be at least 500 words long.	–	–	–

Application of Number Level 1

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
N1.1 Interpret information from **two** different sources. At least **one** source must include a table, chart, graph or diagram.	✓	✓	✓
N1.2 Carry out and check calculations to do with: a amounts or sizes b scales or proportion c handling statistics.	✓	✓	✓
N1.3 Interpret the results of your calculations and present your findings – in two different ways using charts or diagrams.	✓	✓	✓

Application of Number Level 2

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
N2.1 Interpret information from a suitable source.	✓	✓	✓
N2.2 Use your information to carry out calculations to do with: a amounts or sizes b scales or proportion c handling statistics d using formulae.	✓	✓	✓
N2.3 Interpret the results of your calculations and present your findings.	✓	✓	✓

Information and Communication Technology Level 1

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
ICT1.1 Find and select relevant information.	✓	✓	✓
ICT1.2 Enter and develop information to suit the task.	✓	✓	✓
ICT1.3 Develop the presentation so that the final output is accurate and fit for purpose.	–	–	–

Information and Communication Technology Level 2

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
ICT2.1 Search for and select information to meet your needs. Use different information sources for each task and multiple search criteria in at least one case.	✓	✓	✓
ICT2.2 Enter and develop the information to suit the task and derive new information.	✓	✓	✓
ICT2.3 Present combined information such as text with image, text with number, image with number.	✓	✓	✓

Working with Others Level 1

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
WO1.1 Confirm you understand the given objectives, and plan for working together.	✓	✓	✓
WO1.2 Work with others towards achieving the given objectives.	✓	✓	✓
WO1.3 Identify ways you helped to achieve things and how to improve your work with others.	✓	✓	✓

Working with Others Level 2

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
WO2.1 Plan work with others.	✓	✓	✓
WO2.2 Work co-operatively towards achieving the identified objectives.	✓	✓	✓
WO2.3 Review your contributions and agree ways to improve work with others.	✓	✓	✓

Improving Own Learning and Performance Level 1

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
LP1.1 Confirm your targets and plan how to meet these with the person setting them.	✓	✓	✓
LP1.2 Follow your plan, to help meet targets and improve your performance	✓	✓	✓
LP1.3 Review your progress and achievements in meeting targets, with an appropriate person.	✓	✓	✓

Improving Own Learning and Performance Level 2

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
LP2.1 Help set targets with an appropriate person and plan how these will be met.	✓	✓	✓
LP2.2 Take responsibility for some decisions about your learning, using your plan to help meet targets and improve your performance.	✓	✓	✓
LP2.3 Review progress with an appropriate person and provide evidence of your achievements.	✓	✓	✓

Problem Solving Level 1

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
PS1.1 Confirm with an appropriate person that you understand the given problem and identify different ways of tackling it.	✓	✓	✓
PS1.2 Confirm with an appropriate person what you will do and follow your plan for solving the problem.	✓	✓	✓
PS1.3 Check with an appropriate person if the problem has been solved and how to improve your problem solving skills.	✓	✓	✓

Problem Solving Level 2

What you must do …	**Signposting of Opportunities for Generating Evidence in Subject Content**		
	AO2	**AO3**	**AO4**
PS2.1 Identify a problem, with help from an appropriate person, and identify different ways of tackling it.	✓	✓	✓
PS2.2 Plan and try out at least one way of solving the problem.	✓	✓	✓
PS2.3 Check if the problem has been solved and identify ways to improve problem solving skills.	✓	✓	✓

10.3	Exemptions for the Key Skills Qualification	GCSE A*- C examination performance on this specification provides exemptions for the external test in Application of Number at Level 2.
10.4	Further Guidance	More specific guidance and examples of tasks that can provide evidence of single Key Skills, or composite tasks that can provide evidence of more than one Key Skill are given in the AQA specification support material, particularly the document 'A Teacher's Guide'.

11 Spiritual, Moral, Ethical, Social, Cultural and Other Issues

11.1	Spiritual, Moral, Ethical, Social, Cultural and Other Issues	Mathematics provides opportunities to promote: • *spiritual development,* through explaining the underlying mathematical principles behind some of the natural forms and patterns in the world around us; • *moral development*, helping pupils recognise how logical reasoning can be used to consider the consequences of particular decisions and choices helping them learn the value of mathematical truth; • *social development*, through helping pupils work together productively on complex mathematical tasks and helping them see that the result is often better than could be achieved separately; • *cultural development*, through helping pupils appreciate that mathematical thought contributes to the development of our culture and is becoming increasingly central to our highly technological future, and through recognising that mathematicians from many cultures have contributed to the development of modern day mathematics.
11.2	European Dimension	AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen papers.
11.3	Environmental Issues	AQA has taken account of the 1988 Resolution of the Council of the European Community and the Report *"Environmental Responsibility: An Agenda for Further and Higher Education"* 1993 in preparing this specification and associated specimen papers.

11.4	Citizenship	Coursework tasks, particularly those for AO4 *Handling data,* promote the skills of enquiry and communication. They also encourage the skill of participation and responsible action in the educational establishment and/or communication.
11.5	Avoidance of Bias	AQA has taken great care in the preparation of this specification and associated specimen papers to avoid bias of any kind.
11.6	Health and Safety	Coursework tasks, particularly those for AO4 *Handling data* provide opportunities to promote Health and Safety issues.
11.7	ICT	(a) Pupils should be given opportunities to apply and develop their ICT capability through the use of ICT tools to support their learning in mathematics. (b) Pupils should be given opportunities to support their work by being taught to: (i) find things out from a variety of sources, selecting and synthesising the information to meet their needs and developing an ability to question its accuracy, bias and plausibility; (ii) develop their ideas using ICT tools to amend and refine their work and enhance its quality and accuracy; (iii) exchange and share information, both directly and through electronic media; (iv) review, modify and evaluate their work, reflecting critically on its quality, as it progresses.
11.8	Other issues	Mathematics provides opportunities to promote: • *thinking skills*, through developing pupils' problem-solving skills and deductive reasoning; • *financial capability*, through applying mathematics to problems set in financial contexts; • *enterprise and entrepreneurial skills*, through developing pupils' abilities to apply mathematics in science and technology, in economics and in risk assessment; • *work related learning*, through developing pupils' abilities to use and apply mathematics in workplace situations and in solving real-life problems.

Internal Assessment (Coursework)

12 Nature of the Coursework Component

12.1 Introduction

There are two alternative approaches to the assessment of the coursework modules:

- **Option T** centres may choose from a bank of coursework tasks provided by AQA or they set their own coursework tasks; centres then mark the coursework tasks with moderation of candidates' coursework by AQA;
- **Option X** centres choose from the bank of coursework tasks provided by AQA and candidates' coursework is marked by AQA.

Apart from the choice of coursework tasks and the method of assessment, the nature of the centre-assessed component is the same for Option T and Option X. The following details apply to both Option T and Option X.

The details for the coursework component are common to AQA GCSE Mathematics (Modular) Specification B.

12.2 AO1 Task

For the AO1 task candidates are expected to submit one task only. . This investigational task must be set in the context of AO2 and/or AO3. The Assessment Criteria for the AO1 task are given in Section 14.4. The coursework task is expected to take approximately two weeks to complete, including lesson and homework time. The AO1 task will be marked out of a total of 24 marks.

12.3 AO4 Task

For the *Handling data* task candidates are expected to submit one task only. It will not be possible for the AO4 task to be used as the AO1 task. Tasks based on probability only, without data handling, are unlikely to score well on these criteria and should be avoided. Simulation activities are acceptable provided that they lead to statistical tasks rather than probability tasks. Candidates may choose to use statistical information from the Internet or other sources. The Assessment Criteria for the AO4 task are given in Section 14.4. The coursework task is expected to take approximately two weeks to complete, including lesson and homework time. The AO4 task will be marked out of a total of 24 marks.

12.4 Scaling

The AO1 and AO4 tasks will each be marked out of a total of 24 marks to give a total out of 48 for the coursework component. Only one task from each of AO1 and AO4 should be submitted, and only one of each will be assessed by AQA.

12.5 Philosophy

It is intended that coursework should be an integral part of the teaching and learning process. It must not be regarded as an additional or separate part of this process. Therefore it is important that the scheme of work includes activities designed to develop the strands that are assessed. The AO4 coursework task provides an opportunity for candidates to carry out an extended piece of work using handling data skills. The AO1 coursework task provides an opportunity for candidates to conduct an extended piece of work which enhances their understanding of the mathematics of AO2 and/or AO3. Candidates are expected to use appropriate mathematical skills to investigate and carry out the tasks. These skills may involve the use of practical equipment and computers where appropriate to the tasks. Tasks should be chosen so that they are appropriate for the candidate and, by their nature, do not limit the mark that can be awarded.

Coursework also provides an appropriate method for generating evidence for the six Key Skills: *Communication, Application of Number, Information and Communication Technology, Working with Others, Improving own Learning and Performance,* and *Problem Solving.*

13 Guidance on Setting the Coursework Component

13.1 AQA-set tasks

Centres entering candidates for Option X must select coursework tasks from the bank of AQA-set tasks.

AQA-set tasks will be published each year on the AQA Website under Qualifications/GCSE/Mathematics A (4301)/Coursework. Tasks may be removed or added from year to year. It is therefore essential that the latest version is used each year.

The AO1 *Using and Applying Mathematics* AQA-set tasks for submission in 2008 are

- Spacers
- Trios
- Fraction Differences
- Equable Shapes
- Number Grid
- Trays

The AO4 *Handling Data* AQA-set tasks for submission in 2008 are

- Reaction Times
- Guestimate
- Memory Game
- Pulse Rate
- Read All About It
- Where in the World

Teachers should note that in the AQA-set *Handling Data* (AO4) tasks the word 'hypothesis' is used for a general prediction which is to be tested.

Centres following Option T may choose from the AQA-set tasks or may choose their own tasks based on the guidance provided in the document *A Teacher's Guide* and coursework support materials.

Centres following Option T may also choose a combination of centre-set and AQA-set tasks.

It is important that teachers consider very carefully all types of activities which will provide valid evidence of achievement. The activities in which candidates are involved should be designed to make reasonable demands and to enable positive achievement to be demonstrated in relation to the Assessment Criteria. The tasks chosen therefore must be open to investigation by a variety of different methods, and be open to investigations that permit candidates to demonstrate their best attainment in all three strands of the marking criteria.

Teachers will find it helpful to refer to the Assessment Criteria when designing tasks. It is particularly important to ensure that the tasks chosen do not limit the mark that can be achieved by the candidate. It is also important that any written or oral guidance given to candidates allows them to make their own choices and to develop the task independently.

13.2 Advice on Group Activities

For the AO4 task it is permissible for candidates to collect data as a group or class. It is important that teachers ensure that the analysis and writing up of this work is carried out individually by candidates, so that the requirements of the specification are met.

13.3 Coursework Advisers

Coursework Advisers are available to assist centres with any matters relating to coursework.

14 Assessment Criteria

14.1 Introduction

There are two different sets of Assessment Criteria for the Assessment of GCSE Mathematics coursework tasks. The Assessment Criteria for *Using and applying mathematics* are used for the AO1 task, and the Assessment Criteria for *Handling data* for the AO4 task.

Each task (AO1/AO4) will be marked out of 24 to give a total out of 48 for the centre-assessed component.

14.2 Using and Applying Mathematics (AO1 task)

Candidates will be assessed in terms of their attainment in each of the following three strands which correspond to the three areas of the Programme of Study for *Using and applying mathematics* at National Curriculum Key Stages 3 and 4.

Strand		Maximum mark
1	Making and monitoring decisions to solve problems	8
2	Communicating mathematically	8
3	Developing skills of mathematical reasoning	8
	Maximum total mark	24

The score in each of the three strands should be that which reflects the best performance by the candidate in that strand. These marks should be totalled to give a mark out of 24.

The criteria are to be used as best fit indicative descriptions and the statements within them are not to be taken as hurdles. It is necessary, however, for the majority of the statement to be met for the mark to be awarded.

The mark descriptions within a strand are designed to be broadly hierarchical. This means that, in general, a description at a particular mark subsumes those at lower marks. Therefore the mark awarded may not be supported by direct evidence of achievement of lower marks in each strand.

It is assumed that tasks which allow higher marks will involve a more sophisticated approach and/or treatment.

The AO1 coursework task must be set in the context of AO2 (*Number and algebra*) and/or AO3 (*Shape, space and measures*).

In these criteria, there is an intended approximate link between 7 marks and grade A, 5 marks and grade C and 3 marks and grade F.

14.3 Handing data (AO4 task)

Candidates will be assessed in terms of their attainment in each of the following three strands which correspond to the Programme of Study for *Handling data* at National Curriculum Key Stages 3 and 4.

Strand		Maximum mark
1	Specify the problem and plan	8
2	Collect, process and represent data	8
3	Interpret and discuss results	8
	Maximum total mark	24

The score in each of the three strands should be that which reflects the best performance by the candidate in that strand. These marks should be totalled to give a mark out of 24.

The criteria are to be used as best fit indicative descriptions and the statements within them are not to be taken as hurdles. This means candidates' work should be assessed in relation to the criteria taken as holistic descriptions of performance. The first consideration is: which of the descriptions in each strand best describes the work in a candidate's task. Once that is established, the final step is to decide between the lower and the higher tier mark available for that description; this decision may well involve looking again at the criteria above and below the selected best-fitting criterion. It is not appropriate to take each statement in each description and regard it as a separate assessment criterion. Nor is it necessary to consider whether the majority of the statements within a criterion have been met.

A mark of 0 should be awarded if a candidate's work fails to satisfy the requirements for 1 mark.

Descriptions for higher marks subsume those for lower marks.

Where there are references to 'meeting the level detailed in the handling data paragraph of the grade description for grade *X*' , work which uses no technique beyond the specified grade is indicative of the lower of the two marks. Work using techniques beyond the specified grade is indicative of the higher of the two marks.

In these criteria, there is an intended approximate link between 7 marks and grade A, 5 marks and grade C and 3 marks and grade F.

14.4 Criteria

The grids on the following pages are the Assessment Criteria for the AO1 and AO4 tasks.

(AO1 task) – Assessment criteria for Using and Applying Mathematics

	Strand 1 Making and monitoring decisions to solve problems	Strand 2 Communicating mathematically	Strand 3 Developing skills of mathematical reasoning
1	Candidates try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results.	Candidates discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams.	Candidates show that they understand a general statement by finding particular examples that match it.
2	Candidates are developing their own strategies for solving problems and are using these strategies both in working within mathematics and in applying mathematics to practical contexts.	Candidates present information and results in a clear and organised way, explaining the reasons for their presentation.	Candidates search for a pattern by trying out ideas of their own.
3	In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible.	Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams.	Candidates make general statements of their own, based on evidence they have produced, and give an explanation of their reasoning.
4	Candidates carry through substantial tasks and solve quite complex problems by breaking them down into smaller, more manageable tasks.	Candidates interpret, discuss and synthesise information presented in a variety of mathematical forms. Their writing explains and informs their use of diagrams.	Candidates are beginning to give a mathematical justification for their generalisations; they test them by checking particular cases.
5	Starting from problems or contexts that have been presented to them, candidates introduce questions of their own, which generate fuller solutions.	Candidates examine critically and justify their choice of mathematical presentation, considering alternative approaches and explaining improvements they have made.	Candidates justify their generalisations or solutions, showing some insight into the mathematical structure of the situation being investigated. They appreciate the difference between mathematical explanation and experimental evidence.

	Strand 1 **Making and monitoring decisions to solve problems**	**Strand 2** **Communicating mathematically**	**Strand 3** **Developing skills of mathematical reasoning**
6	Candidates develop and follow alternative approaches. They reflect on their own lines of enquiry when exploring mathematical tasks; in doing so they introduce and use a range of mathematical techniques.	Candidates convey mathematical meaning through consistent use of symbols.	Candidates examine generalisations or solutions reached in an activity, commenting constructively on the reasoning and logic employed, and make further progress in the activity as a result.
7	Candidates analyse alternative approaches to problems involving a number of features or variables. They give detailed reasons for following or rejecting particular lines of enquiry.	Candidates use mathematical language and symbols accurately in presenting a convincing reasoned argument.	Candidates' reports include mathematical justifications explaining their solutions to problems involving a number of features or variables.
8	Candidates consider and evaluate a number of approaches to a substantial task. They explore extensively a context or area of mathematics with which they are unfamiliar. They apply independently a range of appropriate mathematical techniques.	Candidates use mathematical language and symbols efficiently in presenting a concise reasoned argument.	Candidates provide a mathematically rigorous justification or proof of their solution to a complex problem, considering the conditions under which it remains valid.

(AO4 task) – Assessment criteria for Handling data

	Strand 1 Specify the problem and plan	Strand 2 Collect, process and represent data	Strand 3 Interpret and discuss results
1-2	Candidates choose a simple well-defined problem. Their aims have some clarity. The appropriate data to collect are reasonably obvious. An overall plan is discernible and some attention is given to whether the plan will meet the aims. The structure of the report as a whole is loosely related to the aims.	Candidates collect data with limited relevance to the problem and plan. The data are collected or recorded with little thought given to processing. Candidates use calculations of the simplest kind. The results are frequently correct. Candidates present information and results in a clear and organised way. The data presentation is sometimes related to their overall plan.	Candidates comment on patterns in the data. They summarise the results they have obtained but make little attempt to relate the results to the initial problem.
3-4	Candidates choose a problem involving routine use of simple statistical techniques and set out reasonably clear aims. Consideration is given to the collection of data. Candidates describe an overall plan largely designed to meet the aims and structure the project report so that results relating to some of the aims are brought out. Where appropriate, they use a sample of adequate size.	Candidates collect data with some relevance to the problem and plan. The data are collected or recorded with some consideration given to efficient processing. Candidates use straightforward and largely relevant calculations involving techniques meeting the level detailed in the handling data paragraph of the grade description for grade F. The results are generally correct. Candidates show understanding of situations by describing them using statistical concepts, words and diagrams. They synthesise information presented in a variety of forms. Their writing explains and informs their use of diagrams, which are usually related to their overall plan. They present their diagrams correctly, with suitable scales and titles.	Candidates comment on patterns in the data and any exceptions. They summarise and give a reasonably correct interpretation of their graphs and calculations. They attempt to relate the summarised data to the initial problem, though some conclusions may be incorrect or irrelevant. They make some attempt to evaluate their strategy.

	Strand 1 Specify the problem and plan	Strand 2 Collect, process and represent data	Strand 3 Interpret and discuss results
5-6	Candidates consider a more complex problem. They choose appropriate data to collect and state their aims in statistical terms with the selection of an appropriate plan. Their plan is designed to meet the aims and is well described. Candidates consider the practical problems of carrying out the survey or experiment. Where appropriate, they give reasons for choosing a particular sampling method. The project report is well structured so that the project can be seen as a whole.	Candidates collect largely relevant and mainly reliable data. The data are collected in a form designed to ensure that they can be used. Candidates use a range of more demanding, largely relevant calculations that include techniques meeting the level detailed in the handling data paragraph of the grade description for grade C. The results are generally correct and no obviously relevant calculation is omitted. There is little redundancy in calculation or presentation. Candidates convey statistical meaning through precise and consistent use of statistical concepts that is sustained throughout the work. They use appropriate diagrams for representing data and give a reason for their choice of presentation, explaining features they have selected.	Candidates comment on patterns in the data and suggest reasons for exceptions. They summarise and correctly interpret their graphs and calculations, relate the summarised data to the initial problem and draw appropriate inferences. Candidates use summary statistics to make relevant comparisons and show an informal appreciation that results may not be statistically significant. Where relevant, they allow for the nature of the sampling method in making inferences about the population. They evaluate the effectiveness of the overall strategy and make a simple assessment of limitations.
7-8	Candidates work on a problem requiring creative thinking and careful specification. They state their aims clearly in statistical terms and select and develop an appropriate plan to meet these aims giving reasons for their choice. They foresee and plan for practical problems in carrying out the survey or experiment. Where appropriate, they consider the nature and size of sample to be used and take steps to avoid bias. Where appropriate, they use techniques such as control groups, or pre-tests of questionnaires or data sheets, and refine these to enhance the project. The project report is well structured and the conclusions are related to the initial aims.	Candidates collect reliable data relevant to the problem under consideration. They deal with practical problems such as non-response, missing data or ensuring secondary data are appropriate. Candidates use a range of relevant calculations that include techniques meeting the level detailed in the handling data paragraph of the grade description for grade A. These calculations are correct and no obviously relevant calculation is omitted. Numerical results are rounded appropriately. There is no redundancy in calculation or presentation. Candidates use language and statistical concepts effectively in presenting a convincing reasoned argument. They use an appropriate range of diagrams to summarise the data and show how variables are related.	Candidates comment on patterns and give plausible reasons for exceptions. They correctly summarise and interpret graphs and calculations. They make correct and detailed inferences from the data concerning the original problem using the vocabulary of probability. Candidates appreciate the significance of results they obtain. Where relevant, they allow for the nature and size of the sample and any possible bias in making inferences about the population. They evaluate the effectiveness of the overall strategy and recognise limitations of the work done, making suggestions for improvement. They comment constructively on the practical consequences of the work.

14.5	Evidence to Support the Award of Marks (Option T only)	Teachers should keep records of their assessments during the course, in a form which facilitates the complete and accurate submission of the final assessments at the end of the course. When the assessments are complete, the marks awarded under each of the assessment criteria must be entered on the *Candidate Record Form*, with supporting information given in the spaces provided. A specimen *Candidate Record Form* appears in Appendix C; the exact design may be modified before the operational version is issued and the correct year's *Candidate Record Forms*, available on the AQA Website (www.aqa.org.uk), should always be used.
14.6	Evidence of Attainment (Option X only)	Where there is ephemeral evidence of attainment, which does not form part of the candidate's written record, brief notes of each candidate's achievement in these skill areas should be provided on the *Candidate Record Form*.

15 Supervision and Authentication

15.1 Supervision of Candidates' Work

Candidates' work for assessment must be undertaken under conditions which allow the teacher to supervise the work and enable the work to be authenticated. If it is necessary for some assessed work to be done outside the centre, sufficient work must take place under direct supervision to allow the teacher to authenticate all of the candidate's work with confidence.

Private candidates who follow Option X and follow an open-learning course with a tutorial college, or attend a part-time course at a school or college, may have their work authenticated by their tutor. Candidates who do not have a tutor must make arrangements to have their work authenticated by a professional person who is in a position to judge that the work is the candidate's own. This will usually be a member of staff at the centre through which the candidate is entered.

15.2 Guidance by the Teacher

The work assessed must be solely that of the candidate concerned. Any assistance given to an individual candidate which is beyond that given to the group as a whole must be recorded on the Candidate Record Form.

Further details on the supervision of coursework and on appropriate guidance for candidates can be found in the document *A Teacher's Guide*.

15.3 Unfair Practice

At the start of the course, the supervising teacher is responsible for informing candidates of the AQA *Regulations* concerning malpractice. Candidates must not take part in any unfair practice in the preparation of coursework to be submitted for assessment, and must understand that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to AQA. The penalties for malpractice are set out in the AQA *Regulations*.

15.4 Authentication of Candidates' Work

Both the candidate and the teacher are required to sign declarations confirming that the work submitted for assessment is the candidate's own. The teacher declares that the work was conducted under the specified conditions, and records details of any additional assistance (see Appendix C).

16 Standardisation (Option T only)

16.1 Standardising Meetings

Annual standardising meetings will usually be held in the autumn term. At these meetings support will be provided for centres in the development of appropriate coursework tasks and assessment procedures.

Centres entering candidates for the first time must send a representative to the meetings. Attendance is also mandatory in the following cases:

- where there has been a serious misinterpretation of the specification requirements;
- where the nature of the coursework tasks set by a centre has been inappropriate;
- where a significant adjustment has been made to a centre's marks in the previous year's examination;

Otherwise attendance is at the discretion of centres.

Copies of the material used at the Standardising Meetings are available, free of charge, from AQA.

16.2 Internal Standardisation of Marking

The centre is required to standardise the assessments across different teachers and teaching groups to ensure that all candidates at the centre have been judged against the same standards. If two or more teachers are involved in marking a component, one teacher must be designated as responsible for internal standardisation. Common pieces of work must be marked on a trial basis and differences between assessments discussed at a training session in which all teachers involved must participate. The teacher responsible for standardising the marking must ensure that the training includes the use of reference and archive materials such as work from a previous year or examples provided by AQA for use at the standardising meeting referred to in 16.1 above. The centre is required to send to the moderator the *Centre Declaration Sheet*, duly signed, to confirm that the marking of centre-assessed work at the centre has been standardised. If only one teacher has undertaken the marking, that person must sign this form.

A specimen *Centre Declaration Sheet* appears in Appendix C.

17 Administrative Procedures

17.1 Recording Assessments (Option T only)

The candidates' work must be marked according to the assessment criteria set out in Section 14.4. The marks and supporting information must be recorded in accordance with the instructions in Section 17.2. The completed *Candidate Record Form* for each candidate must be attached to the work and made available to AQA on request.

17.2 Submitting Marks and Sample Work for Moderation (Option T only)

The total mark for each candidate must be submitted to AQA on the mark sheets provided or by Electronic Data Interchange (EDI) by the specified date. Centres will be informed which candidates' work is required in the samples to be submitted to the moderator.

17.3 Factors affecting Individual Candidates

Teachers should be able to accommodate the occasional absence of candidates by ensuring that the opportunity is given for them to make up missed assessments.

Special consideration should be requested for candidates whose work has been affected by illness or other exceptional circumstances. Information about the procedure to be followed is issued separately.

If work is lost, AQA should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. AQA will advise on the procedures to be followed in such cases.

Where special help which goes beyond normal learning support is given, AQA must be informed so that such help can be taken into account when assessment and moderation take place. This should be recorded on the individual *Candidate Record Forms*.

Candidates who move from one centre to another during the course may require different procedures. Possible courses of action depend on the stage at which the move takes place. If the move occurs early in the course the new centre should take responsibility for assessment. If it occurs late in the course it may be possible to accept the assessments made at the previous centre. Centres should contact AQA at the earliest possible stage for advice about appropriate arrangements in individual cases.

17.4 Retaining Evidence and Re-using Marks (Option T only)

The centre must retain the work of all candidates, with the completed *Candidate Record Forms* attached, under secure conditions, from the time it is assessed, to allow for the possibility of an enquiry about results. The work may be returned to candidates after the issue of results provided that no enquiry about result is to be made which will include re-moderation of the coursework. If an enquiry about result is to be made, the work must be retained under secure conditions until requested by AQA.

Candidates re-taking the examination may carry forward their moderated coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification, and they may be carried forward an unlimited number of times within this shelf-life.

18 Moderation (Option T only)

18.1 Moderation Procedures

Moderation of the coursework is by inspection of a sample of candidates' work, sent by post from the centre to a moderator appointed by AQA. The centre marks must be submitted to AQA and the sample of work must reach the moderator by the specified date in the year in which the qualification is awarded.

Following the re-marking of the sample work, the moderator's marks are compared with the centre marks to determine whether any adjustment is needed in order to bring the centre's assessments into line with standards generally. In some cases it may be necessary for the moderator to call for the work of other candidates. In order to meet this possible request, centres must have available the coursework and *Candidate Record Form* of every candidate entered for the examination and be prepared to submit them, to the Moderator, on demand. Mark adjustments will normally preserve the centre's order of merit, but where major discrepancies are found, AQA reserves the right to alter the order or merit.

18.2 Post-Moderation Procedures

On publication of the GCSE results, the centre is supplied with details of the final marks for the coursework.

The candidates' work is returned to the centre after the examination with a report form from the moderator giving feedback to the centre on the appropriateness of the tasks set, the accuracy of the assessments made, and the reasons for any adjustments to the marks.

Some candidates' work may be retained by AQA for archive purposes or for use at AQA Standardising Meetings.

Awarding and Reporting

19 Grading, Shelf-life and Re-sits

19.1	Qualification Titles	The qualification based on this specification has the following title: AQA General Certificate of Secondary Education in Mathematics.
19.2	Grading System	The qualification will be graded on an 8 point grade Scale A*, A, B, C, D, E, F, G. Candidates who fail to reach the minimum standard for grade G will be recorded as U (unclassified) and will not receive a qualification certificate. Candidates must be entered for either the Foundation tier or Higher tier. For candidates entered for the Foundation tier, grades C–G are available. For candidates entered for the Higher tier grades A*-D are available. There is a safety net for candidates entered for the Higher tier, where an allowed Grade E will be awarded where candidates just fail to achieve Grade D. Candidates who fail to achieve a Grade E on the Higher tier or Grade G on the Foundation tier will be reported as U (unclassified).
19.3	Re-sits	Re-sits at both tiers will be available in November.
19.4	Minimum Requirements	Candidates will be graded on the basis of work submitted for assessment.
19.5	Carrying Forward of Centre-assessed Marks	Candidates re-taking the examination may carry forward their moderated or examiner-marked coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification, and they may be carried forward an unlimited number of times within this shelf-life.
19.6	Awarding and Reporting	The procedures for Awarding Grades and Reporting Results to centres comply with the GCSE Code of Practice issued by the Regulatory Authorities.

Appendices

A

Grade Descriptions

The following grade descriptors indicate the level of attainment characteristic of the given grade at GCSE. They give a general indication of the required learning outcomes at each specific grade. The descriptors should be interpreted in relation to the content outlined in the specification; they are not designed to define that content.

The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives (as in Section 6) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

Grade A

Candidates give reasons for the choices they make when investigating within mathematics itself or when using mathematics to analyse tasks: these reasons explain why particular lines of enquiry or procedures are followed and others rejected. Candidates apply the mathematics they know in familiar and unfamiliar contexts. Candidates use mathematical language and symbols effectively in presenting a convincing reasoned argument. Their reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.

Candidates manipulate simple surds. They determine the bounds of intervals. Candidates understand and use direct and inverse proportion. They manipulate algebraic formulae, equations and expressions, finding common factors and multiplying two linear expressions. In simplifying algebraic expressions, they use rules of indices for negative and fractional values. They solve problems using intersections and gradients of graphs.

Candidates sketch the graphs of sine, cosine and tangent functions for any angle and generate and interpret graphs based on these functions. Candidates use sine, cosine and tangent of angles of any size, and Pythagoras' theorem when solving problems in two and three dimensions. They use the conditions for congruent triangles in formal geometric proofs. They calculate lengths of circular arcs and areas of sectors, and calculate the surface area of cylinders and volumes of cones and spheres. They understand and use the effect of enlargement on areas and volumes of shapes and solids.

Candidates interpret and construct histograms. They understand how different methods of sampling and different sample sizes may affect the reliability of conclusions drawn; they select and justify a sample and method, to investigate a population. They recognise when and how to work with probabilities associated with independent and mutually exclusive events.

Grade C

Starting from problems or contexts that have been presented to them, candidates refine or extend the mathematics used to generate fuller solutions. They give a reason for their choice of mathematical presentation, explaining features they have selected. Candidates justify their generalisations, arguments or solutions, showing some insight into the mathematical structure of the problem. They appreciate the difference between mathematical explanation and experimental evidence.

In making estimates candidates use appropriate techniques and multiply and divide mentally. They solve numerical problems involving multiplication and division with numbers of any size using a calculator efficiently and appropriately. They understand the effects of multiplying and dividing by numbers between 0 and 1. They use ratios in appropriate situations. They understand and use proportional changes. Candidates find and describe in symbols the next term or the nth term of a sequence, where the rule is linear. Candidates calculate one quantity as a percentage of another. They multiply two expressions of the form $(x + n)$; they simplify the corresponding quadratic expressions. They solve simple polynomial equations by trial and improvement and represent inequalities using a number line. They formulate and solve linear equations with whole number coefficients. They manipulate simple algebraic formulae, equations and expressions. Candidates draw and use graphs of quadratic functions.

Candidates solve problems using angle and symmetry properties of polygons and properties of intersecting and parallel lines. They understand and apply Pythagoras' theorem when solving problems in two-dimensions. Candidates solve problems involving areas and circumferences of circles. They calculate lengths, areas and volumes in plane shapes and right prisms. Candidates enlarge shapes by a positive whole number or fractional scale factor. They appreciate the imprecision of measurement and recognise that a measurement given to the nearest whole number may be inaccurate by up to one half in either direction. They understand and use compound measures such as speed. Candidates use mathematical instruments to carry out accurate constructions of loci.

Candidates construct and interpret frequency diagrams with grouped data. They specify hypotheses and test them. They determine the modal class and estimate the mean, median and range of a set of grouped data, selecting the statistic most appropriate to their line of enquiry. They use measures of average and range with associated frequency polygons, as appropriate, to compare distributions and make inferences. Candidates understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.

Grade F

In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible. Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams. They draw simple conclusions of their own and give an explanation of their reasoning.

Candidates use their understanding of place value to multiply and divide whole numbers and decimals by 10, 100 and 1000. They order, add and subtract negative numbers in context. They use all four operations with decimals to two places. They reduce a fraction to its simplest form by cancelling common factors and solve simple problems involving ratio and direct proportion. They calculate fractional or percentage parts of quantities and measurements, using a calculator where necessary. Candidates understand and use an appropriate non-calculator method for solving problems involving multiplying and dividing any three-digit by any two-digit number. In solving problems with or without a calculator, candidates check the reasonableness of their results by reference to their knowledge of the context or to the size of the numbers, by applying inverse operations or by estimating using approximations. Candidates explore and describe number patterns and relationships including multiple, factor and square. They construct, express in symbolic form, and use simple formulae involving one or two operations.

When constructing models and when drawing, or using shapes, candidates measure and draw angles as accurately as practicable, and use language associated with angle. They know the angle sum of a triangle and that of angles at a point. They identify all the symmetries of 2-D shapes. They know the rough metric equivalents of imperial units still in daily use and convert one metric unit to another. They make sensible estimates of a range of measures in relation to everyday situations. Candidates calculate areas of rectangles. Candidates use co-ordinates in all four quadrants to locate and specify points.

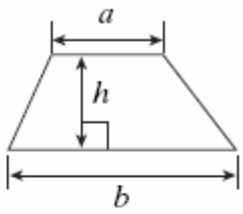
Candidates understand and use the mean of discrete data. They compare two simple distributions using the range and one of the mode, median or mean. They interpret graphs and diagrams, including pie charts, and draw conclusions. They understand and use the probability scale from 0 to 1. Candidates make and justify estimates of probability by selecting and using a method based on equally likely outcomes or on experimental evidence as appropriate. They understand that different outcomes may result from repeating an experiment.

B

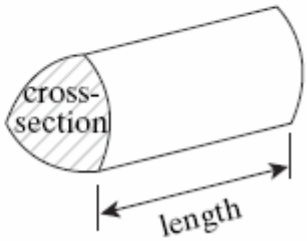
Formulae Sheets

Foundation Tier

Area of trapezium = $\frac{1}{2}(a+b)h$

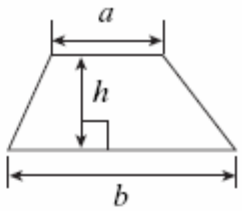


Volume of prism = area of cross-section × length

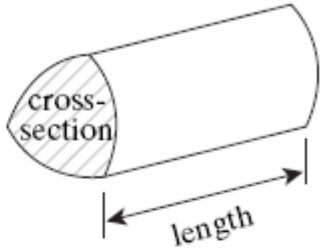


Higher Tier

Area of trapezium = $\frac{1}{2}(a+b)h$

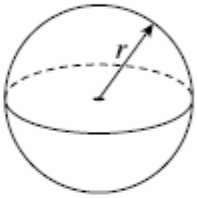


Volume of prism = area of cross-section × length



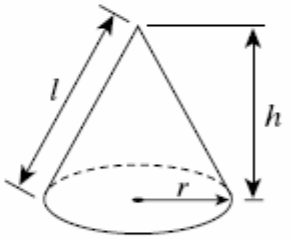
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

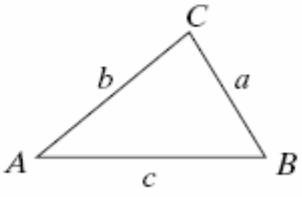


In any triangle ABC

Area of triangle = $\frac{1}{2}ab\sin C$

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

C

Record Forms

AQA ASSESSMENT and QUALIFICATIONS ALLIANCE

SAMPLE ONLY

Centre-assessed work
Centre Declaration Sheet
2008

Qualification: ✓ ELC ☐ GCSE ☐ GCE ☐ FSMQ ☐ Key Skills ☐

Specification title: ..... **Unit code(s):** .....

Centre Name: ..... **Centre No:** ☐☐☐☐☐

Authentication of candidates' work

This is to certify that marks/assessments have been given in accordance with the requirements of the specification and that every reasonable step has been taken to ensure that the work presented is that of the candidates named.

Any assistance given to candidates beyond that given to the class as a whole and beyond that described in the specification has been recorded on the *Candidate Record Form*(s) and has been taken into account. The marks/assessments given reflect accurately the unaided achievement of the candidates.

Signature(s) of teacher(s) responsible for assessment

Teacher 1: ..... **Teacher 2:** .....

Teacher 3: ..... **Teacher 4:** .....

Teacher 5: ..... **Teacher 6:** .....

(Continue overleaf if necessary)

Internal Standardisation of Marking

Each centre must standardise the assessments for this unit across different teachers/assessors and teaching groups to ensure that all candidates in the centre have been judged against the same standards.

If two or more teachers/assessors are involved in marking a unit, one of them must be designated as responsible for standardising the assessments of all teachers/assessors at the centre.

I confirm that *[tick either (a) or (b)]*

☐ (a) the procedure described in the specification has been followed at this centre to ensure that the assessments are of the same standard for all candidates; or

☐ (b) I have marked/assessed the work of all candidates.

Signed: ..... **Date:** .....

Signature of Head of Centre ..... **Date:** .....

This form should be completed and sent to the moderator with the sample of centre-assessed work.

AQA ASSESSMENT and QUALIFICATIONS ALLIANCE

SAMPLE ONLY

Centre-assessed work Candidate Record Form 2008

GCSE Mathematics A (Option T) 4301

Centre name: ..... **Centre no:** | | | | | |

Candidate name: ..... **Candidate no:** | | | | |

This side is to be completed by the candidate

Sources of advice and information

1 Have you received any help or information from anyone other than your subject teacher(s) in the production of this work? (Write YES or NO) .....
If you have answered YES, give details below. Continue on a separate sheet if necessary.

.....

2 If you have used **any** books, information leaflets or other materials (e.g. videos, software packages or information from the Internet) to help you complete this work, you must list these below, unless they are clearly acknowledged in the work itself. To present material copied from books or other sources without acknowledgement will be regarded as deliberate deception.

.....

.....

NOTICE TO CANDIDATE

The work you submit for assessment must be your own.

If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified from at least the subject concerned.

Declaration by candidate

I have read and understood the **Notice to Candidate** (above). I have produced the attached work without any help apart from that which I have stated on this sheet.

As part of AQA's commitment to assist students, AQA may make your coursework available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your coursework is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns, please contact crf@aqa.org.uk

Candidate's signature: ..... **Date:** .....

This form should be completed and attached to the candidate's work and retained at the Centre or sent to the moderator as required.

PTO

Candidate name: ..... **Candidate no:** | | | | |

This side is to be completed by the teacher

Marks must be awarded in accordance with the instructions and criteria in Section 14 of the specification.

Supporting information to show how the marks have been awarded should be given in the form of annotations on the candidate's work and in the spaces below.

If submitted for moderation, this form will be detached and retained by AQA.

Summary of assessment evidence

AO1 (One task only)

Strand	Criteria for award of marks	Max. mark	Mark awarded	Key evidence
1	Making and monitoring decisions to solve problems	8		
2	Communicating mathematically	8		
3	Developing skills of mathematical reasoning	8		
	Total	**24**		

AO4 (One task only)

Strand	Criteria for award of marks	Max. mark	Mark awarded	Key evidence
1	Specify the problem and plan	8		
2	Collect, process and represent data	8		
3	Interpret and discuss results	8		
	Total	**24**		
	Total mark	**48**		

Details of additional assistance given (if any)

Record here details of any assistance given to this candidate which is beyond that given to the class as a whole, and beyond that described in the specification. Continue on a separate sheet if necessary.

Teacher's signature: ..... **Date:** .....

AQA ASSESSMENT and QUALIFICATIONS ALLIANCE

SAMPLE ONLY

Centre-assessed work Candidate Record Form 2008

GCSE Mathematics A (Option X) 4301

Centre name: ..... **Centre no:** | | | | | |

Candidate name: ..... **Candidate no:** | | | | |

This side is to be completed by the candidate

Sources of advice and information

1 Have you received any help or information from anyone other than your subject teacher(s) in the production of this work? (Write YES or NO) .....

2 If you have answered YES, give details below. Continue on a separate sheet if necessary.

.....

3 If you have used **any** books, information leaflets or other materials (e.g. videos, software packages or information from the Internet) to help you complete this work, you must list these below, unless they are clearly acknowledged in the work itself. To present material copied from books or other sources without acknowledgement will be regarded as deliberate deception.

.....

.....

NOTICE TO CANDIDATE

The work you submit for assessment must be your own.

If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified from at least the subject concerned.

Declaration by candidate

I have read and understood the **Notice to Candidate** (above). I have produced the attached work without any help apart from that which I have stated on this sheet.

As part of AQA's commitment to assist students, AQA may make your coursework available on a strictly anonymous basis to teachers, examining staff and students in paper form or electronically, through the Internet or other means, for the purpose of indicating a typical mark or for other educational purposes. In the unlikely event that your coursework is made available for the purposes stated above, you may object to this at any time and we will remove the work on reasonable notice. If you have any concerns, please contact crf@aqa.org.uk

Candidate's signature: ..... **Date:** .....

This form should be completed and attached to the candidate's work and retained at the Centre or sent to the moderator as required.

PTO

Candidate name: ..... **Candidate no:** | | | | |

Teachers are strongly advised to provide comments as evidence of mathematical or statistical thinking where this is not clearly communicated in the work. This may be done in the body of the script or on a separate sheet.

This form will be detached and retained by AQA.

Declaration by the teacher

Details of additional assistance given (if any)

Record here details of any assistance given to this candidate which is beyond that given to the class as a whole and beyond that described in the specification. Continue on a separate sheet if necessary.

Teacher's signature: ..... **Date:** .....

To be completed by the examiner

AO1 task

Strand	Key evidence	Final assessed score (0–8)
1		
2		
3		
	Total (max. 24)	

AO4 task

Strand	Key evidence	Final assessed score (0–8)
1		
2		
3		
	Total (max. 24)	
	Total mark (max. 48)	
	Examiner's initials	

D

Overlaps with other Qualifications

The content of this specification is identical, though differently structured, to that of AQA GCSE Mathematics Specification B.

There is some overlap between GCSE Mathematics Specification A and GCSE Statistics.

There is some overlap of skills and content between GCSE Mathematics Specification A, Free Standing Mathematics Qualifications (FSMQs) and the Key Skill of *Application of Number*. In some post-16 centres candidates on the different courses may be grouped together.

Further information about the links between these subjects can be obtained from AQA.